US007908473B2

(12) **United States Patent**
Matze

(10) **Patent No.: US 7,908,473 B2**
(45) **Date of Patent: Mar. 15, 2011**

(54) **SYSTEM FOR STORING ENCRYPTED DATA BY SUB-ADDRESS**

(75) Inventor: **John E. G. Matze**, Poway, CA (US)

(73) Assignee: **Exar Corporation**, Fremont, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 970 days.

(21) Appl. No.: **11/750,836**

(22) Filed: **May 18, 2007**

(65) **Prior Publication Data**

US 2008/0288772 A1 Nov. 20, 2008

(51) **Int. Cl.**
H04L 29/08 (2006.01)

(52) **U.S. Cl.** **713/151**; 713/152; 713/153; 713/160; 709/203; 709/213; 709/214; 709/215; 709/217; 709/229; 719/312; 719/326

(58) **Field of Classification Search** ..... None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,706,502	A	1/1998	Foley et al.	
5,727,129	A	3/1998	Barrett et al.	
5,761,663	A	6/1998	Lagarde et al.	
5,768,528	A	6/1998	Stumm	
5,832,522	A	11/1998	Blickenstaff et al.	
6,332,025	B2	12/2001	Takahashi et al.	
6,895,461	B1 *	5/2005	Thompson	710/305
7,325,075	B1 *	1/2008	Chiu et al.	709/245
2003/0115447	A1 *	6/2003	Pham et al.	713/153
2004/0030770	A1 *	2/2004	Pandya	709/223
2005/0013441	A1	1/2005	Klein	
2005/0172199	A1 *	8/2005	Miller et al.	714/749
2006/0069926	A1	3/2006	Ginter et al.	

FOREIGN PATENT DOCUMENTS

EP	1328104	A2	7/2003

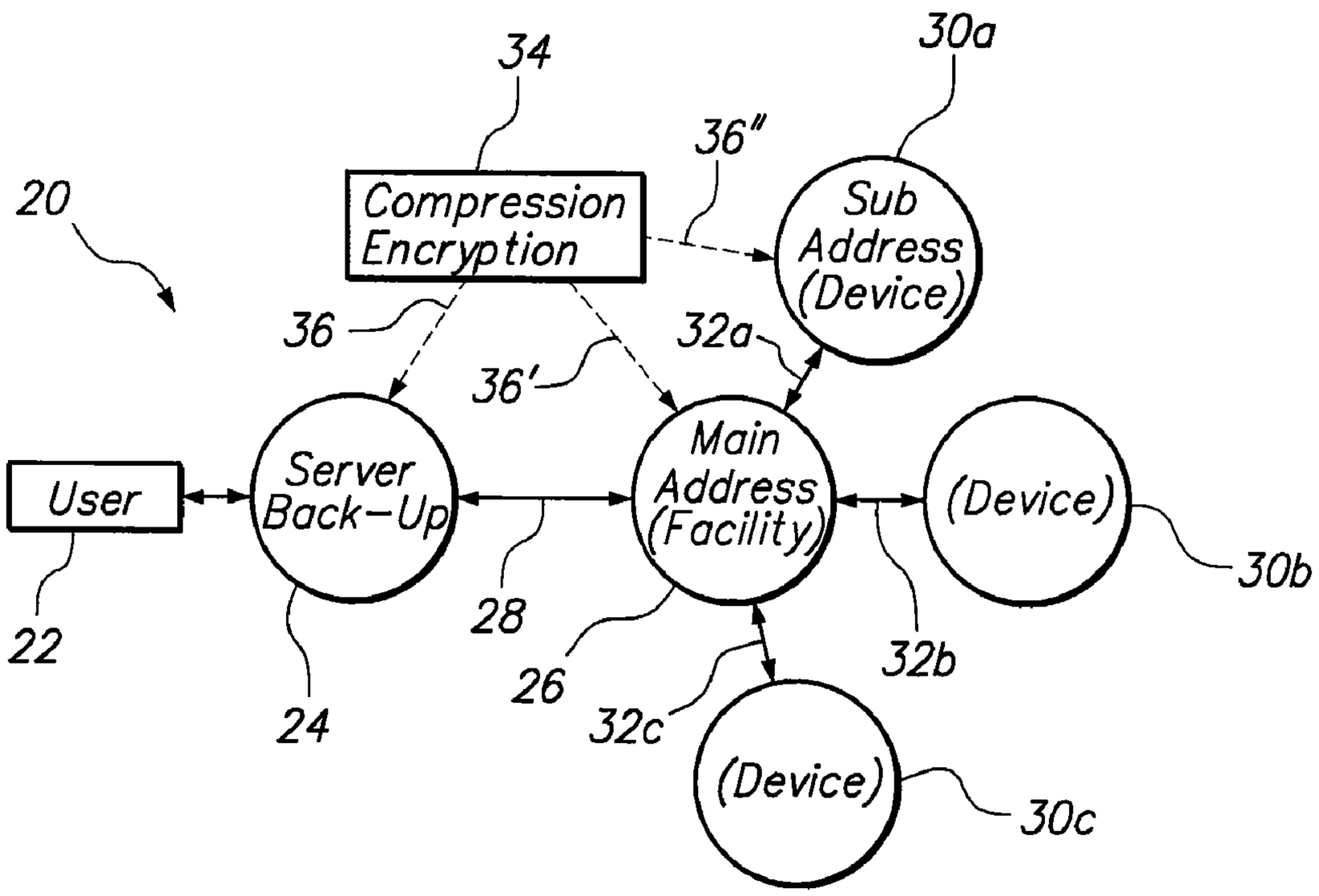
* cited by examiner

Primary Examiner — Taghi T Arani
Assistant Examiner — Amir Mehrmanesh
(74) *Attorney, Agent, or Firm* — Nydegger & Associates

(57) **ABSTRACT**

A system and method for storing encrypted electronic data using a transmission Control Protocol (TCP), requires leaving both the header and the first 48 bytes of the "0" data packet in the data area of the TCP format in clear text. Consequently, the data can be routed to a main address (storage facility), and then to a sub-address (storage device) for storage. A single compression/encryption operation can be accomplished, before storage, at the host (server), the network switch, or the final storage device.

9 Claims, 1 Drawing Sheet



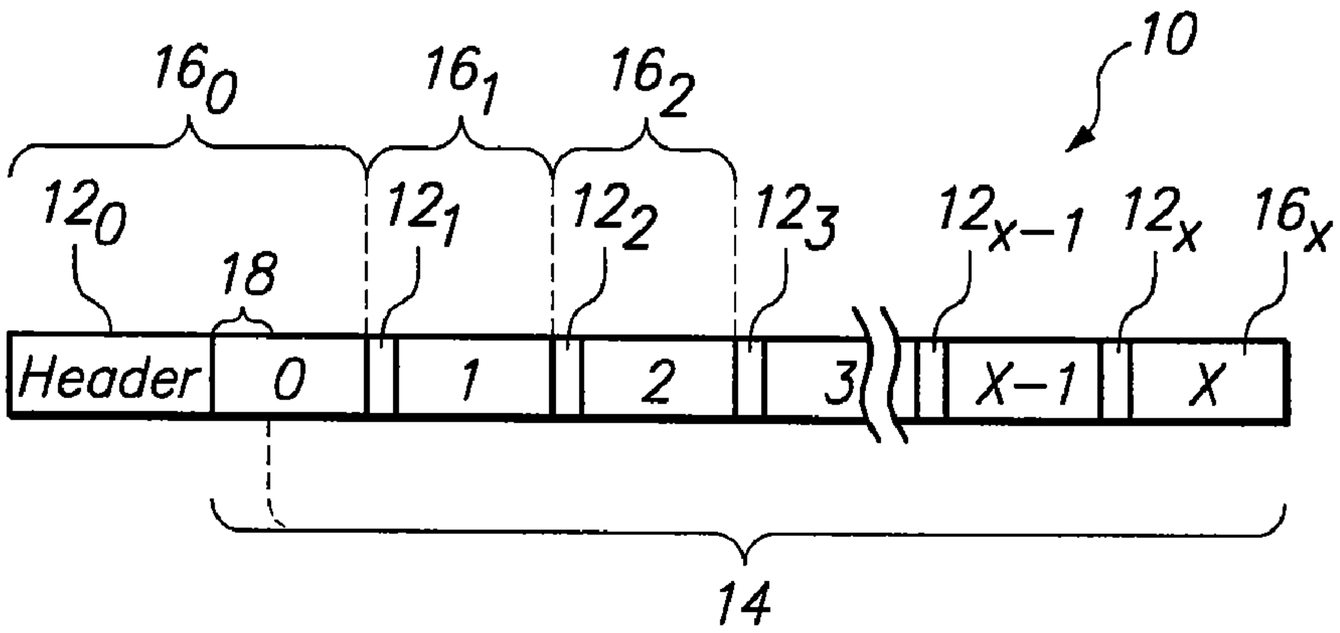

16₀
16₁
16₂
10
12₀
12₁
12₂
12₃
12x−1
12x
16x
18
Header
0
1
2
3
X−1
X
14

FIG. 1

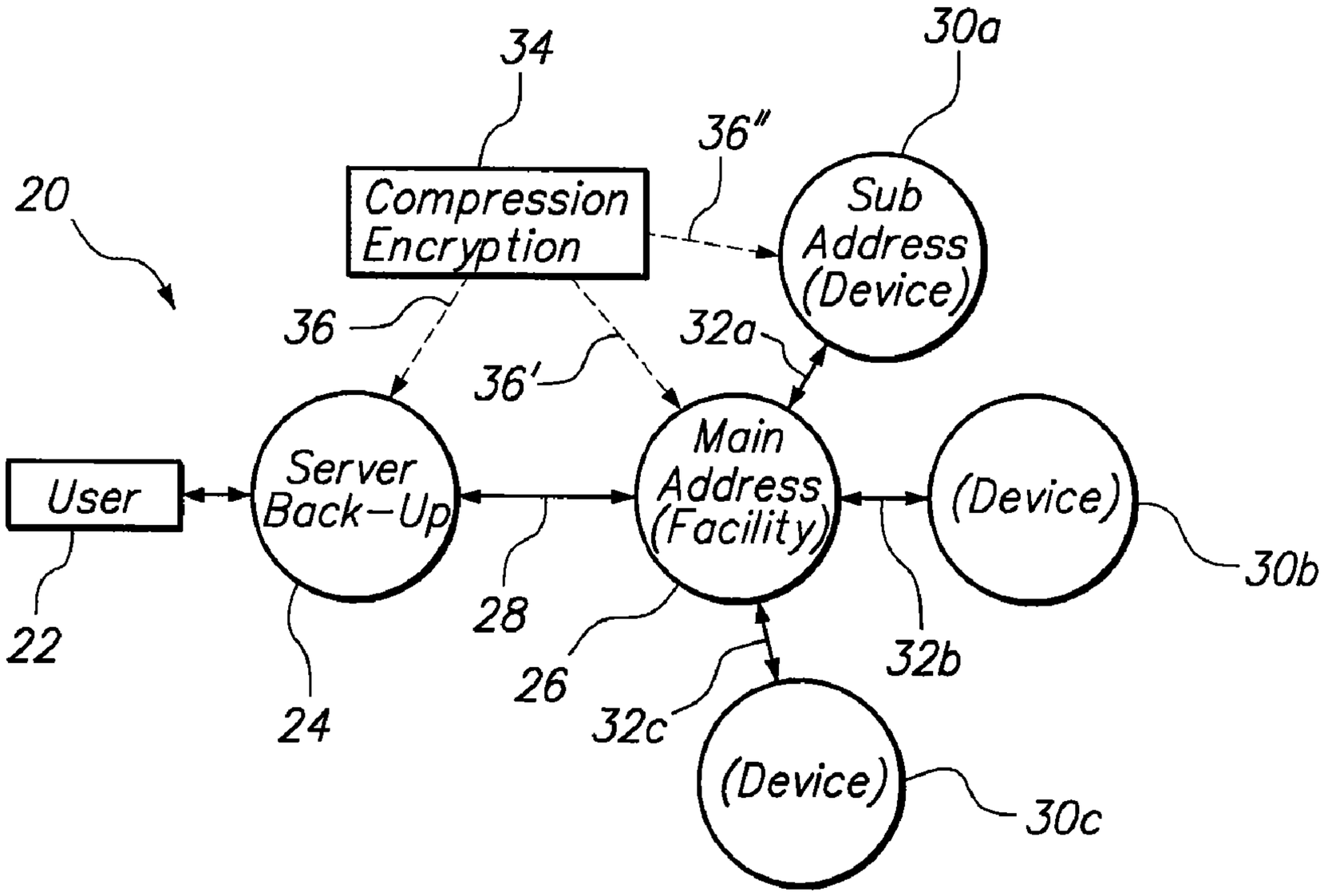

34
30a
36″
20
Compression
Encryption
Sub
Address
(Device)
36
32a
36′
Server
Back−Up
Main
Address
(Facility)
(Device)
30b
User
22
28
24
26
32b
32c
(Device)
30c

FIG. 2

SYSTEM FOR STORING ENCRYPTED DATA BY SUB-ADDRESS

FIELD OF THE INVENTION

The present invention pertains generally to systems and methods for storing encrypted electronic data. More particularly, the present invention pertains to systems and methods for transferring electronic data through a sequence of addresses for final storage. The present invention is particularly, but not exclusively, useful as a system and method for transferring electronic data wherein all sequential addresses remain in clear text.

BACKGROUND OF THE INVENTION

Computer systems typically have a limited, finite storage capacity on the site where they are installed and used. Invariably, with time, the system gets over-loaded and this capacity becomes operationally insufficient. Nevertheless, it often happens that the electronic data generated by a computer system has archival value and cannot be casually discarded. Moreover, for security reasons, or for compliance with good business practices, it may be desirable to remove such electronic data from a host server at an operating location, and place it into secure storage. In such cases it is often preferable to place the data into long term, non-temporary storage at an off-site storage facility. If so, it is important the electronic data be moved directly from the user site to a storage device at the storage facility, quickly and conveniently. A well-known Transmission Control Protocol (TCP) is typically used for this purpose.

In accordance with TCP, a stream of electronic data (i.e. a data file) that is to be transferred into storage from a host server is broken down into an "x+1" number of data packets. These data packets are then numbered from "0" to "x" and, in toto, include 32 K bytes of data. Collectively, these data packets are referred to as the "data area." TCP, however, also requires the use of a "header." In use, this header precedes the first data packet, and includes the address of the storage facility where the data is to be sent. TCP, however, provides for only two addresses in the header. These are: 1) the source address, and 2) the destination address. Also, whenever it is desirable to encrypt the electronic data for storage, as is most often the case, the header must remain in clear text. It cannot be encrypted. This is so in order to reveal the destination address of the encrypted electronic data (data file) in the header, as it is being transferred into storage.

It happens that most data storage facilities will serve several customers, and will thus have several different storage devices. Indeed, such facilities may even dedicate specific storage devices to particular customers. In such cases, when a data file arrives at a storage facility, additional routing to a particular storage device is required. As indicated above, the header of a TCP transmission does not provide for routing beyond the main address (i.e. destination address) of the storage facility. In order to handle this situation, it has been the practice to place the sub-address of a particular storage device in the first 48 bytes of the "0" data packet in the data area of the TCP protocol. Typically, this is done using the so-called ISCSI protocol. Thus, when an encrypted data area has arrived at a storage facility, the "0" data packet in the data area has required decryption in order to determine the final destination of the storage device where the data is to be stored.

In light of the above, it is an object of the present invention to provide a method and system for transferring encrypted electronic data from a host server, via the main address of a storage facility, to a final sub-address of a storage device, wherein the sub-address of the storage device in the data area of a TCP protocol remains in clear text. Another object of the present invention is to provide a method and system for transferring encrypted electronic data wherein the encryption/decryption functions are minimized. Still another object of the present invention is to provide a method and system for transferring encrypted electronic data that is easy to use, simple to implement and comparatively cost effective.

SUMMARY OF THE INVENTION

In accordance with the present invention, a system and method for storing an encrypted data file at a specific storage device in a particular storage facility is provided. For the present invention, this requires transferring the data file to a main address (storage facility), and then routing the data file to a sub-address (storage device) for storage. Importantly, this is done while avoiding encryption of both the main address of the storage facility, and the sub-address of the storage device.

According to a standard Transmission Control Protocol (TCP), an electronic data file is formatted to have a header that is followed by a data area. Typically, when the data file needs to be encrypted, only the data area is encrypted. The header, which includes routing instructions to the main address of the storage facility, is not encrypted and remains in clear text. On the other hand, the sub-address of the final storage device is placed in the encrypted data area. Importantly, the sub-address of a final storage device is typically found in a 48 byte ISCSI that is at the beginning of the "0" data packet in the data area of the TCP format.

In operation, a data file that is to be placed in storage is compressed/encrypted in any manner well known in the pertinent art, such as by the use of a commercially available chip that is manufactured by HIFN. This can be done either at the host (server), the network switch, or the final storage device.

In accordance with normal procedures, the TCP header of the file is not encrypted. For the present invention, the 48 bytes of the ISCSI, which are at the start of the first data packet and which include the sub-address of the final storage device, are also not encrypted. Instead, both the main address (storage facility) and the sub-address (storage device) remain in clear text and are always available for use in transferring a data file to its intended destination. Importantly, for this transfer, only one compress/encrypt operation is required before the data file is placed in storage. Similarly, only one decrypt/decompress operation is required when the data file is recovered from storage.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features of this invention, as well as the invention itself, both as to its structure and its operation, will be best understood from the accompanying drawings, taken in conjunction with the accompanying description, in which similar reference characters refer to similar parts, and in which:

FIG. **1** is a schematic drawing of an electronic data file for use with the present invention; and

FIG. **2** is a schematic drawing of a data transmission routing system used by the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring initially to FIG. **1**, an electronic data file in accordance with the present invention is shown and is generally designated **10**. In accordance with a standard Transmission

Control Protocol (TCP), the data file **10** includes a plurality of data packets **16** and, as shown, each data packet **16** has its own header **12**. For identification purposes, the data packets **16** are sequentially numbered from "0" to "x". Collectively, a portion of the first data packet $\mathbf{16}_0$ and all of the subsequent data packets $\mathbf{16}_1$ through $\mathbf{16}_x$ constitute a 32 K data area **14**. As also shown in FIG. **1**, the "0" data packet $\mathbf{16}_0$ has a "48 byte" portion **18** that immediately follows its header $\mathbf{12}_0$.

In FIG. **2**, a system, generally designated **20**, is shown wherein a user **22** has control over a back-up server **24**. As envisioned by the present invention, electronic data files **10** that are generated routinely or periodically by the user **22**, will be temporarily held on the back-up server **24**. Eventually, however, the data file **10** will need to be securely stored at a long-term, non-temporary storage facility **26**. To do this, the back-up server **24** is somehow connected to a storage facility **26** via a connection **28**. Importantly, to ensure this communication connection is effective, the storage facility **26** will have a specific main address of a type and format well known in the pertinent art. Importantly, the data file **10** needs to be sent to this main address.

Still referring to FIG. **2**, it will be seen that different storage devices **30** will be associated with the storage facility **26**. By way of example, the storage devices **30***a*, **30***b* and **30***c* are shown in FIG. **2** and are each respectively connected to the storage facility **26** via lines **32***a*, **32***b* and **32***c*. For purposes of the present invention each storage device **30** may be of any type well known in the pertinent art, such as a library, a disk, a tape or a DVD. In any event, each storage device **30** will have a specific sub-address. For example, consider the storage device **30***a*. If the storage device **30***a* is to be used, the user **22** will need to first send the appropriate data file **10** from the back-up server **24** via connection **28** to the main address of the storage facility **26**. From there, the data file **10** will then be sent via line **32***a* to the sub-address of the storage device **30***a*.

As indicated above, it is typical, and most likely desirable, for the data file **10** to be compressed and encrypted for its storage on a storage device **30**. For the present invention, this is done by a device **34** in a manner well known in the pertinent art, such as by the use of a commercially available chip manufactured by HIFN. Further, as indicated by the dashed lines **36**, **36'** and **36"** in FIG. **2** the compression/encryption of the data file **10** can be selectively accomplished either at the server **24**, at the storage facility **26** (network switch), or at a storage device **30***a,b,c*.

In operation, the data file **10** is prepared. Specifically, the main address of the storage facility **26** is placed in the header $\mathbf{12}_0$ as required by TCP. The sub-address of the particular storage device **30** where the data file **10** is to be stored is placed in the portion **18** of the "0" data packet $\mathbf{16}_0$. Exclusive of the portion **18** of the "0" data packet $\mathbf{16}_0$, the data area **14** of the data file **10** is then compressed and encrypted by the device **34**. As disclosed above, this compression/encryption can be done either at the server **24**, at the storage facility **26** (network switch), or at a storage device **30***a, b* or *c*. Only one compression/encryption function is required, and conversely, when the data file **10** is to be retrieved and removed from the storage device **30**, only one decryption/decompression function will be required. An important aspect of the present invention is that, regardless where the data file **10** is moved, the main address of the storage facility **26** in the header **12**, and the sub-address of the storage device **30** in the portion **18** of the data area **14**, are never encrypted and always remain in clear text.

While the particular System for Storing Encrypted Data by Sub-Address as herein shown and disclosed in detail is fully capable of obtaining the objects and providing the advantages herein before stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or design herein shown other than as described in the appended claims.

What is claimed is:

1. A method for transferring encrypted electronic data from a host server, via a main address of a storage facility, to a final sub-address of a storage device, the method comprising the steps of:

identifying a header portion and a data area for the electronic data being transferred, wherein the header portion includes the main address of the storage facility;

dividing the data area into a first part and a second part, wherein the sub-address of the storage device is in the first part;

encrypting the second part of the data area;

transferring the electronic data, via the main address, to the sub-address of the storage device;

wherein the header portion and data area are established in accordance with a Transmission Control Protocol (TCP);

wherein the data area includes an "x+1" number of data packets, sequentially numbered from "0" through "x", and wherein the first part of the data area is in the "0" data packet; and

wherein the first part of the data area is structured in accordance with ISCSI protocol and comprises the first 48 bytes of the "0" data packet.

2. A method as recited in claim **1** wherein the header and the first part of the data area are transferred to the storage facility, and to the storage device in clear text.

3. A method as recited in claim **1** wherein the encrypting step is accomplished at the storage facility.

4. A method as recited in claim **1** wherein the encrypting step is accomplished at the storage device.

5. A method for storing electronic data to a storage device, wherein the electronic data is formatted in accordance with a Transmission Control Protocol (TCP) and has a header with a main address and a data area, the method comprising the steps of:

dividing the data area into a first part and a second part, wherein the sub-address of the storage device is in the first part;

encrypting the second part of the data area;

transferring the electronic data to a main address of a storage facility;

routing the electronic data from the main address of the storage facility to a sub-address of the storage device for storage;

wherein the data area includes an "x+1" number of data packets, sequentially numbered from "0" through "x", and wherein the first part of the data area is in the "0" data packet; and

wherein the first part of the data area is structured in accordance with ISCSI protocol and comprises the first 48 bytes of the "0" data packet.

6. A method as recited in claim **5** wherein the encrypting step is accomplished after the transferring step.

7. A method as recited in claim **5** wherein the header and the first part of the data area are transferred to the storage facility, and to the storage device in clear text.

8. A method as recited in claim **5** wherein the encrypting step is accomplished at the storage facility.

9. A method as recited in claim **5** wherein the encrypting step is accomplished at the storage device.

* * * * *